

Question 1: What is the intended temperature range for the N-ZERO devices and microsystems (both technical areas)?

Answer: The operating temperature range is not specified in the BAA. Since the N-ZERO program is concerned with developing rapidly adoptable technology, performers should make reasonable assumptions about the optimal operating temperature range.

Question 2: The specs in the TA-1A of the BAA, < 30pJ, -60dBm, <10s could be interpreted as mutually exclusive. Is there inconsistency in specifying the above parameters?

Answer: The specs in the BAA are consistent: -60dB is the max instantaneous RF power, and 30pJ is the max total integrated energy in the received signal for each processed event. The 10s limit does not refer to integration time. Instead, it sets the maximum time to receive the RF key signature. The duty cycle of the signature is not specified (can be chosen by the proposer).

Question 3: What do you mean by "parameters of an RF tone signal"?

Answer: Examples are frequency, time-modulation (on-off keying, duty cycle), phase or frequency modulation, etc.

Question 4: Are any forms of device duty-cycling excluded?

Answer: Any proposals that do not monitor for the RF or physical signature 100% of the time are non-responsive.

Question 5: Are there any requirements/expectations about the microsystems physical size and/or integration/packaging?

Answer: There is no requirement for integration of physical size in the BAA. However, considerations for signal loss due to parasitic R and C will likely impose size restrictions. The physical size must be within reason for the proposed application.

Question 6: Are there any limitations on the power supply of the N-ZERO system?

Answer: No. However, all power supply functions (i.e. voltage regulation) must be included into the 10 nW power budget.

Question 7: Are latching switches allowed as part of the N-ZERO systems?

Answer: There is no specific restriction forbidding latching switches as long as the system can be recycled for continuous use. Any required energy to "unlatch" the switches, must be included in the 10 nW power budget.

Question 8: Is behavioral learning from the environment of interest?

Answer: We encourage proposers to go beyond the minimum requirements of the BAA. Any approach that will enhance sensor reconfigurability or improved POD/FAR is of interest.

Question 9: Is there a role for universities in TA-1?

Answer: The BAA has no restrictions regarding who may respond to any technical area. As stated in the BAA (page 27), "all responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA." Note that TA-1 requires material deliverables, which will influence the award instrument type (for example, assistance instruments will not be appropriate for TA-1).

Question 10: Is it acceptable to revisit technologies that are not necessarily high-risk?

Answer: Technologies that minimize risk while delivering the program goals are of interest. As in all DARPA programs: "The proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice."

Question 11: Is the power required to deliver the 1V wake-up bit to the COTS system included in the 10nW power budget?

Answer: As stated on pg. 6 of the BAA, "The *near zero power* requirement is defined throughout this document as the average power consumption of the N-ZERO system not exceeding 10 nW, given a specified noise background when the signature of interest is not present." To restate: The 10 nW limit encompasses all energy consumption when real events are not present in the environment. If positive detection for a real event is made, the power will not be counted towards the 10 nW limit. However, any false alarm triggers will be part of the 10 nW limit.

Question 12: Can the power instantaneously exceed the 10 nW limit?

Answer: Yes, 10 nW refers to an average power consumption when no events are present in the environment. As stated on pg. 6 of the BAA, "The *near zero power* requirement is defined throughout this document as the average power consumption of the N-ZERO system not exceeding 10 nW, given a specified noise background when the signature of interest is not present."

Question 13: In TA-2, are there specific requirements for coupling the sensor to the signal?

Answer: No. For testing purposes, the device will be mounted and coupled in a way specified by the proposer, which should be a reasonable approximation for a real life usage scenario.

Question 14: What are the power limitations if a sensor requires temperature control/stabilization?

Answer: As stated on pg. 6 of the BAA, "The *near zero power* requirement is defined throughout this document as the average power consumption of the N-ZERO system not exceeding 10 nW, given a specified noise background when the signature of interest is not present." The power for temperature control of any part of the N-ZERO systems, including any type of sensor utilized, will be part of the 10 nW limitation.

Question 15: Certain types of bio-chem sensors have limited lifetime in the environment. Are such sensors of interest?

Answer: The goal of the N-ZERO program is to deliver maintenance-free sensors that last for years and are only limited by power leakage. Sensors that will last shorter than the embedded power source (battery) will not be considered.

Question 16: Do we have to follow the example approaches in the Proposer's Day brief?

Answer: No. The brief contains only notional examples to help illustrate some of the challenges that the Government foresees. The proposers should not be restricted by any notional examples given in the brief or in the BAA. We are open to consider any innovative approaches that provide credible solutions and fulfill the program's goals.

Question 17: Is there a classified component to this BAA?

Answer: No. However, classified proposals will be accepted, as outlined in the BAA.

Question 18: Are the RF data samples a representation of the time domain voltage across a 50 ohm resistor?

Answer: Yes, the data is quantized voltage in a system where the signal is applied across a 50 ohm load. The A/D has a .55V maximum peak-peak swing (rail to rail input is -.27V to .27V). The quantizer is a 10 bit A/D (-512 to 511 counts) so a single count voltage delta is about .53mV.

Question 19: What is the quantization step size for the RF data? Is the quantization noise a significant factor in the RF data?

Answer: The thermal noise level was set to about a 2 count sigma, so the quantization noise (.289 sigma) is quite small in comparison.

Question 20: Do we have the option of only meeting a subset of the stated metrics in the BAA for a given Technical Area?

Answer: No. All metrics for the Technical Area to be addressed must be met.

Question 21: In Table 3 of the BAA, we couldn't quite understand the "Sub-Threshold Swing", can you give us some more information on how this is defined? Also, in Table 5 how is "Sub-Threshold Swing" for the comparator defined?

Answer: A swing of x/Dec is when an input between 0 mV and the threshold voltage is increased by x , the current increases by a factor of 10. An example that is responsive to the Phase II metric of the BAA is if moving an input voltage from x mV to $x+0.5$ mV (where $0 < x < V_t$ and $0 < x+0.5 \text{ mV} < V_t$) results in an increase in current from y to at least $10*y$.

Question 22: In Table 5, what does the "Number of comparators on a single die" mean? Does this mean the power consumption of 3 or 10 comparators should be less than 10nW all together?

Answer: Each individual comparator and anything that is needed to make the comparator work has a 10nW average power budget. This metric is to acknowledge that designs must be viable as stated on pages 24 and 25 of the BAA and does not imply that they must be manufactured in any specific manner.

Question 23: In Table 5, is the "Resistance at $V_{in} = V_t$ " the input or output resistance?

Answer: The output resistance when the voltage input is equal to the threshold voltage.

Question 24: For, TA-2C, is there a limit on the minimum speed of the comparator?

Answer: Proposed designs are expected to perform within reasonable time scales with appropriate justifications.

Question 25: Are the test conditions in TA-1 used in TA-2? For instance, does a TA-2A microsystem need to distinguish between a car and a generator?

Answer: No, TA-1 and TA-2 are separate areas. In fact, replication of TA-1 objectives in TA-2 is discouraged on pages 20 and 21 of the BAA.

Question 26: Are the TA-1B microsystems tested against only one machine at a time?

Answer: No, there may be multiple machines and background clutter. For example, during Phases II and III the microsystem might have to distinguish a truck and generator running simultaneously, both in the presence of background noise.

Question 27: Should I only provide information about the first Phase of the program in my proposal?

Answer: No. Any proposal that only refers to part of the program is non-responsive to the BAA.

Question 28: What average power levels are acceptable to the program in Phase I?

Answer: The average power specification for all Phases is 10 nW. Any proposal that does not meet the average power specification for all Phases is non-responsive to the BAA.